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1965 KVICHAK RIVER RED SALMON (Oncorhynchus nerka) SMOLT STUDIES

by

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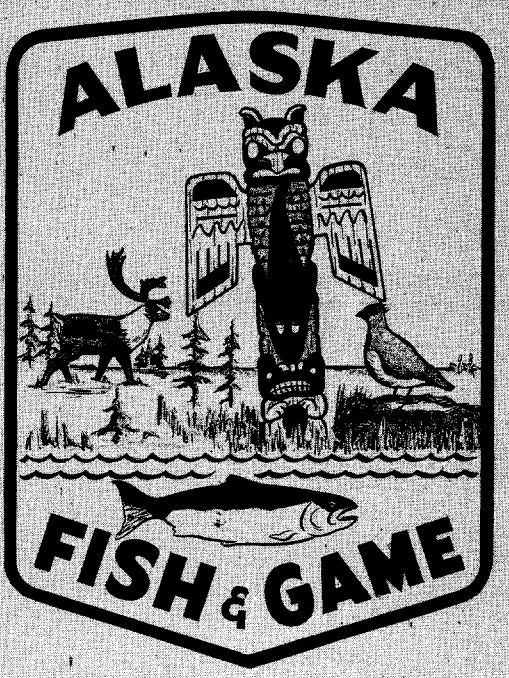

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1965 KVICHAK RIVER RED SALMON (Oncorhynchus nerka) SMOLT STUDIES

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I.) INTRODUCTION

The Kvichak River outmigration project is designed to provide an index of the relative annual abundance of red salmon (Oncorhynchus nerka) smolt leaving Lake Iliamna and migrating down the Kvichak River to the Bering Sea. This index of abundance is used to predict adult red salmon returns to the Kvichak system and to evaluate production from various levels of escapement. Data on age, length and weight of smolt are also collected.

The project was initiated by the Fisheries Research Institute, University of Washington, in 1955. It was under their supervision from 1955-1960 and again in 1962, when they operated it under contract to the Alaska Department of Fish and Game. In 1961 and from 1963 through 1965, the Alaska Department of Fish and Game, Division of Commercial Fisheries has been responsible for maintaining the project, and has provided all temporary personnel and material. The Research Section, formerly Division of Biological Research, of the Division of Commercial Fisheries has been responsible for overall project supervision, planning, data analysis and reporting in 1963-1965. Mr. Angus Robertson, Bristol Bay Assistant Area Management Biologist, assisted in the supervision of the field program in 1965.

The "1964 Kvichak River Red Salmon (Oncorhynchus nerka) Smolt Studies" report (ADF&G Information Leaflet No. 58) by Seibel and Pennoyer described in detail methods, procedures, analysis of past data, and gear used. This information will not be repeated here unless some change was noted in 1965. The section headings in this report have been kept consistent with the 1964 report.

Data and information from past reports on the Kvichak smolt programs is used in this report without footnote reference. A list of these reports is given in the bibliography.

II.) METHODS AND PROCEDURES.

Location and method of fishing, gear used, and sampling procedures did not vary from 1964. A single fyke net with a four-foot square frame was fished at the index site (Fig. 1). The wings of the net were spread to fish a nine-foot wide section of the river. Once the migration began, the net was fished as much as possible on a 24-hour per day basis.

III.) DISCUSSION OF THE 1965 SMOLT PROJECT.

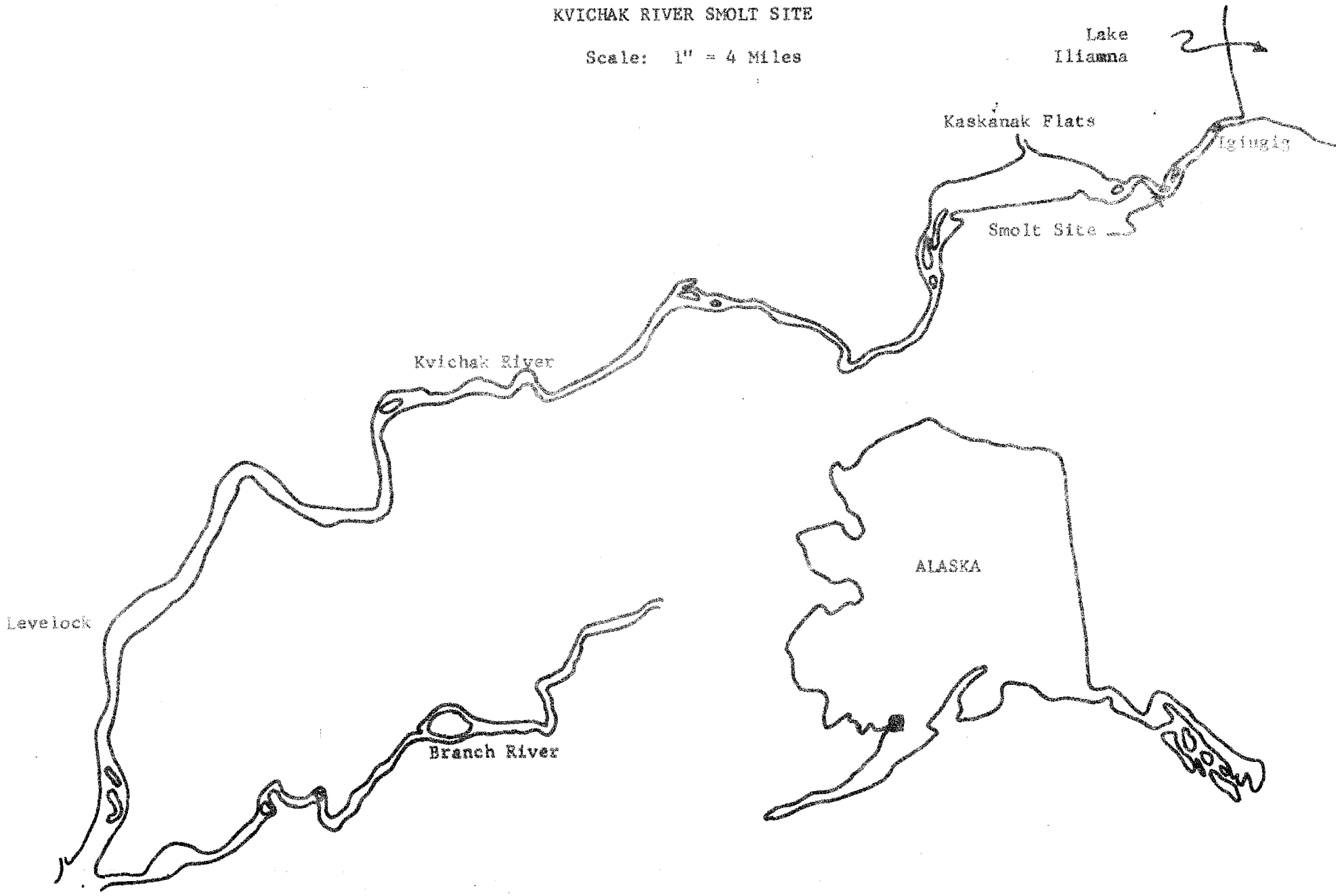
A.) Dates of Sampling, Ice Interference, Climatological and Hydrological Data.

Unusually warm weather in the spring of 1965 lead to early breakup of the

Figure 1

KVICHAK RIVER SMOLT SITE

Scale: 1" = 4 Miles



Iliamna ice pack and aerial observation on May 15 showed large open leads in the ice. The Kvichak River was open and clear of ice. Personnel, equipment and supplies were flown in to Iguigig by a Cessna 180 on Floats and a Widgeon from King Salmon on May 15. Fishing commenced on May 18 and continued through June 13, at which time catches indicated that the majority of outmigrating smolt had passed the site.

Ice floes in the river from breakup of the Lake Iliamna ice pack have seriously interfered with fishing of the index net in some years. However, in 1965, the ice flow was over prior to the beginning of the smolt outmigration. Ice was first seen in the river on May 17 and the ice flow on May 19 and 20 was so heavy that it was impossible to fish. By May 21 only slush ice and small floes remained in the river. As can be seen in Table 4, significant numbers of smolt did not start to outmigrate until May 24.

Table 1 presents climatological and water temperature, turbidity and river level data. During the 1965 season there were several days of high winds, usually from the north or northeast. These winds cause wave action in the lake which is responsible for turbidity in the river. On several occasions the water became so cloudy that the river bottom could not be seen in two feet of water making it impossible to find and relocate the fyke net anchors.

The winds also caused large amounts of debris to wash down the river. Kerns (1961) identified much of the debris that year as being colonial diatoms, (Gomphonema sp.). This debris was present in especially large quantities on May 26, 29, 30 and June 6, but even ommnights of relatively clear water, there was enough debris to clog the net. This net clogging caused increased water resistance and resulted in pulling of the anchors, water going over instead of through the wings and body of the net, and on several occasions accidental release and collapse of the net due to release ring failure. Brushing the net in the water while fishing partially alleviated the problem, but the only way to solve it would have been to change nets. Since only one net was available that the photo-counters would work with, changes were infrequent. Actually, since the ice flow was over prior to the outmigration, the only loss of fishing time was due to debris and equipment failures.

Table 1 shows that the water temperatures were fairly high (38°F) at the start of the project, dropped during the three days of ice flow and began to increase again on May 21. It was not until May 24, when the water temperatures had reached 41°F, that the peak outmigration began.

B.) Calibration of the Photo-Electric Counters.

Since photo-electric counters were first used to derive an index of smolt abundance on the Kvichak in 1962, a great deal of discussion has been devoted to the evaluation of the efficiency of these counters. Table 2 compares fish per count ranges and averages for the four years 1962-1965. The ranges and seasonal averages for all years are roughly similar but there is considerable variation from day to day in any given year. This variation may be due to power source variation, water turbidity, debris, or density of outmigration.

TABLE 1

CLIMATOLOGICAL AND RIVER OBSERVATIONS 1/
KVICHAK RIVER 1965, May 17-June 11

Date	Air Temp. 8a.m. 2/	Water Temp. 8a.m.	Water Temp. 6p.m.	Wind Max. mph	Turbidity	River Level in Inches 3/
5/17	---	38	38	0	Clear	7
18	---	38	38	0	Clear	8
19	42°F	34	33	3N	Glacial-Ice in River	9 1/4
20	42	32	34	30E	Glacial-Ice in River	12 3/4
21	47	35	38	2N	Glacial-Ice in River	6 3/4
22	42	38	40	4N	Turbid	6 1/4
23	39	40	40	0	Slightly Turbid	7 3/4
24	48	40	41	3N	Slightly Turbid	7
25	36	41	41	5NE	Clear	8 3/4
26	38	41	41	25NE	Slightly Turbid	9 1/4
27	34	43	41	15NE	Clear	10 1/4
28	---	41	41	2NE	Turbid	---
29	---	41	41	10NE	Very Turbid	12
30	41	41	41	3NE	Turbid	12 1/2
31	40	41	41	1NE	Clear	13
6/ 1	38	41	41	0	Clear	12 3/4
2	43	41	41	20NE	Turbid	12 1/2
3	44	42	42	0	Clear	12 3/4
4	50	41	42	0	Clear	12 3/4
5	45	42	40	40NE	Clear	14 3/4
6	43	42	41	30NE	Turbid	14 1/2
7	46	40	40	5NE	Slightly Turbid	14 1/4
8	50	40	41	3NE	Clear	14 1/4
9	55	41	41	10NE	Clear	15 1/2
10	50	46	42	20NE	Slightly Turbid	16 1/2
11	68	48	---	1SE	Clear	15 3/4

1/ Observations were taken approximately 1/2 mile below the outlet of Lake Iliamna at the scow site.
2/ Maximum-minimum thermometer out of order.
3/ Water gauge set at 7" with surface of water on May 17. Surface of water 6.9' below level of Bench Mark. Water level taken at 6 p.m. daily.

TABLE 2

KVICHAK RIVER
COMPARATIVE PHOTO-ELECTRIC COUNTER CALIBRATION DATA
FOR RED SALMON SMOLT 1962 - 1965

Year	FISH PER COUNT Range of all Calibrations	FISH PER COUNT Range of Daily or Period Averages	Seasonal Average
1962	2.85-10.31	4.72- 8.38	6.17
1963	3.63-14.88	4.07- 7.94	7.21
1964	4.34-12.10	5.08- 8.19	6.36
1965	2.36-13.34	3.22-10.00	5.61

It would seem wise to continue to obtain daily calibration data to evaluate these variations.

One point that should be mentioned here is the variation caused by handling of the gear. The variation caused by different crews doing the calibration may exceed the variation by natural causes. Slight changes in the way the net is held, cod end affixed, etc., may have a very great effect on the calibration counts and catches particularly during periods of peak migration. This topic is discussed further under the section "Recommendations for Future Smolt Projects."

Table 3 shows the detailed calibration data for 1965. Daily fish per count was obtained by totalling all the fish caught during that day's calibrations and dividing them by the total number of counts (e.g., on May 24-25, during seven calibrations, 9,279 fish were caught for 1400 counts yielding a daily average of 6.63 fish per count). As can be seen in Table 3, calibration sampling on some days was quite minimal. Analysis of covariance of the four primary days of calibration sampling revealed that the daily ratios were not significantly different ($F = 0.437$ where an F value of >0.866 would be required for a significant difference). It was therefore decided to use a seasonal estimator instead of the daily ratios to convert counts to fish. The seasonal average of 5.61 fish per count was obtained by computing a linear regression through the origin with fish per minute the dependent variable and counts per minute the independent variable.

It has been noted in the past that counter efficiency tends to decrease as passage rate increases. This may become especially important during periods of very large outmigration. However, cursory examination of the 1965 calibration data does not reveal such a trend, possibly because passage rates in 1965 did not reach the levels of 1963 and 1964.

C.) Interpolation and Total Smolt Index.

As in past years, the 1965 index fishing was divided into twenty-four hour "days" from noon of one day to noon of the following day. These "days" were further divided into five periods: 1200-2200; the index hours 2200-2300, 2300-2400, and 0000-0100; and 0100-1200. The catch data by day and by period is presented in Table 4.

Four basic rules consistent with past years were used to arrive at the total estimated index catch from the daily catch data.

1.) If any part of one of the five periods listed above was fished, the catch was expanded by direct proportion. This rule is subject to some subjective treatment; e.g., if fishing from 1500-2100 yielded a 0 catch and from 2100-2200, 1,000 fish were caught, the hours 1200-1500 were assumed to have a 0 catch since catches would be expected to increase toward evening.

2.) If one of the index hours was missing, the average catch of the other two index hours was used.

TABLE 3

KVICHAK RIVER RED SALMON SMOLT PHOTOCOUNTER CALIBRATION DATA, 1965

Daily Period	Hour	Fishing Time (Minutes)	Weight (lbs.)	Fish Per Pound	Total Fish	Counts	Counts Per Minute	Fish Per Minute	Fish Per Count	Daily Averages
5/23-24	0100	48.25			129	40	0.83	2.7	3.22	
										3.22
5/24-25	2200	3.08	32.75	39	1277	200	64.94	414.6	6.38	
	2300	1.50	41.00	39	1599	200	133.33	1066.0	8.00	
	2300	2.85	31.50	39	1228	200	70.18	430.9	6.14	
	2300	13.95	33.75	39	1316	200	14.34	94.3	6.58	
	2300	8.67	33.00	36	1188	200	23.07	137.0	5.94	
	0000	5.70	34.25	42	1438	200	29.85	214.6	7.19	
	0000	17.55	34.25	36	1233	200	11.40	70.3	6.16	
										6.63
5/25-26	0000	78.98	19.00	42	798	140	1.77	10.1	5.70	
										5.70
5/26-27	2200	1.77	25.50	40	1020	200	112.99	576.3	5.10	
	2300	0.42	35.25	39	1375	200	476.19	3273.8	6.88	
	2300	0.35	25.25	38	960	200	571.43	2742.9	4.80	
	2300	0.85	20.50	42	861	200	235.29	1012.9	4.30	
	2300	28.10	24.75	42	1040	200	7.12	37.0	5.20	
										5.26
5/27-28	2200	2.03	29.50	41	1210	200	98.52	596.1	6.05	
	2300	0.52	24.50	40	980	200	384.62	1884.6	4.90	
										5.48
5/28-29	2200	57.38	13.50	45	608	80	1.39	10.6	7.60	
	0000	52.75	24.00	42	1008	170	3.22	19.1	5.93	
										6.46

TABLE 3
KVICHAK RIVER RED SALMON SMOLT PHOTOCOUNTER CALIBRATION DATA, 1965
(Cont.)

Daily Period	Hour	Fishing Time (Minutes)	Weight (lbs.)	Fish Per Pound	Total Fish	Counts	Counts Per Minute	Fish Per Minute	Fish Per Count	Daily Averages
5/30-31	1000	16.67	18.00	50	900	200	12.00	54.0	4.50	
	1000	0.75	22.00	46	1012	200	266.67	1349.3	5.06	
	1100	14.58	9.25	51	472	200	13.72	32.4	2.36	
	1100	2.47	20.50	48	984	210	85.02	398.4	4.69	
	1100	7.40	19.50	50	975	210	28.38	131.8	4.64	
										4.26
5-31-6/1	2200	13.38	20.00	48	960	200	14.95	71.7	4.80	
	2200	6.80	21.00	45	945	200	29.41	139.0	4.72	
	2200	23.58	22.50	45	1012	200	8.48	42.9	5.06	
	2300	32.53	18.50	46	851	200	6.15	26.2	4.26	
										4.71
6/5-6	0000	54.25	19.00	50	950	160	2.95	17.5	5.94	
										5.94
6/6-7	2300	5.00	58.00	46	2668	200	40.00	533.6	13.34	
	2300	9.33	29.00	46	1334	200	21.44	143.0	6.67	
										10.00
								Seasonal Average		5.61

TABLE 4

KVICHAK RIVER RED SALMON SMOLT TWENTY-FOUR HOUR INDEX CATCH BY PERIOD, 1965 [1/]

Date	1200-2200	2200-2300	2300-2400	0000-0100	Index Hour Total	0100-1200	Daily Total	Accumulative Total
5/17-18	----	----	----	1	1	2	3	3
18-19	0	0	0	5	5	----	5	8
19-20		No	Fishing	Due To	Ice			
20-21		No	Fishing	Due To	Ice			
21-22	0	12	6	17	35	----	35	43
22-23	----	142	36	55	233	----	233	276
23-24	33	869	492	78	1,439	7,964	9,436	9,712
24-25	154,643	94,075	21,604	15,632	131,311	245,658	531,612	541,324
25-26	78,540	15,932	850	397	17,179	1,570	97,289	638,613
26-27	75,309	285,571	59,394	56	345,021	1,261	421,591	1,060,204
27-28	31,408	96,662	196,217	1,661	294,540	602	326,550	1,386,754
28-29	19,850	453	729	1,020	2,202	55,543	77,595	1,464,349
29-30	162,524	56	337	505	898	24,128	187,550	1,651,899
30-31	1,881	0	0	0	0	22,520	24,401	1,676,300
5/31-6/1	27,698	5,168	1,870	0	7,038	5,050	39,786	1,716,086
1-2	3,584	112	673	358	1,143	7,348	12,075	1,728,161
2-3	0	112	112	168	392	1,606	1,998	1,730,159
3-4	0	224	56	168	448	0	448	1,730,607
4-5	5,862	8,864	4,488	(6,676)	20,028	(2,777)	28,667	1,759,274
5-6	(8,401)	(6,115)	(4,151)	988	11,254	5,554	25,209	1,784,483
6-7	10,940	3,366	3,814	0	7,180	78	18,198	1,802,681
7-8	0	0	561	1,122	1,683	----	1,683	1,804.364
8-9	0	393	561	1,403	2,357	----	2,357	1,806,721
9-10	0	1,066	2,917	1,683	5,666	----	5,666	1,812,387
10-11	0	112	0	0	112	----	112	1,812,499
11-12	----	0	0	0	0	----	0	1,812,499
12-13	----	0	56	0	56	----	56	1,812,555
13-14	----	0	0	0	0	----	0	1,812,555
TOTALS	580,673	519,304	298,924	31,993	850,221	381,661	1,812,555	1,812,555

1/ Figures appearing in parenthesis have been estimated as no part of the period was sampled. Dashed indicate no sample was taken and interpolation was considered unnecessary.

3.) If two of the index hours were missing and the catches for these hours on the preceding and following days were available, the average catch of these hours were used for the missing hours.

4.) If either of the two periods 1200-2200 or 0100-1200 were missing and the catches for these periods on the preceding and following days were available, the average of these catches were used for the missing period.

Primarily due to the early breakup of the Lake Iliamna ice pack and the subsequent early outflow of ice in the river, very few fishing periods were entirely missed. Interpolated catches for periods in which there was no sampling are indicated by parenthesis in Table 4. These catches total only 35,169 fish fish or 1.9% of the total index catch estimate. No estimate of the effect of gear inefficiency due to net clogging or anchors dragging and gear fishing too deep is possible. However, the small amount of interpolation necessary indicates that the 1965 index catch estimate is probably less subject to error than either that of 1963 or 1964.

Again in 1965, there was a tremendous variation in the index catch from day to day and hour to hour, further substantiating the need to fish twenty-four hours a day, seven days per week. Examination of Table 4 also illustrates the difficulty in making any general statements about the relationship between catches inside the index hours as opposed to those outside.

Table 5 and 6 give comparative dates of sampling, periods of peak outmigration, total outmigration, and percent outmigration during the index hours for the years 1955-1965. Figure 2 illustrates the daily index catches in 1965.

D.) Numbers, Length and Weight of Smolt by Age Group.

From May 23 - June 13, scale samples were taken from 134 smolt in the 88 - 115mm. length range (all lengths are from tip of snout to fork of tail). Age I smolt (fish that had spent one winter in the lake) were found up to 99mm. in length and Age II (fish that had spent two winters in the lake) were found as small as 95mm. in length. Age I smolt, however, occurred infrequently in this area of overlap and this is reflected in the selection of 95-96mm. as the dividing point between Age I and Age II fish. Percent Age II fish in the daily catches is shown in Figure 3, illustrating the lack of Age I fish early in the season.

Table 7 shows the weighted length frequency distribution for Age I and Age II smolt in 1965. Age I smolt comprised 3.6% of the catch and averaged 90.1mm. in length, while Age II smolt comprised 96.4% of the catch and averaged 108.9mm. in length. This data was computed from nightly length frequency samples weighted by the corresponding index catch. Figure 4 gives the weighted length-frequency curve for smolt in 1965.

Only two samples were taken during the season comparing length frequencies of smolt migrating during daylight and darkness. The results were inconclusive.

TABLE 5

DATES OF SAMPLING AND PEAK PERIODS OF RED SALMON SMOLT OUTMIGRATION
Kvichak River, 1955-1965

	Total Sampling Period		Period of Peak Outmigration		
Year	Date	Number of Days	Date	Number of Days	Percent of Total Catch
1955	5/28-6/27	31	6/4-9	6	94%
1956	5/24-7/4	42	6/1-9, 14-16	12	88
1957	5/28-7/24	58	5/28-6/6	10	84
1958	5/10-7/5	56	5/22-6/3	13	80
1959	5/23-6/28	36	5/26-6/2	8	98
1960	5/18-6/19	33	5/28-6/4	8	80
1961	5/23-6/20	29	5/23-6/2	11	81
1962	5/27-7/4	39	6/2-15	14	88
1963	5/16-6/16	32	5/24-29 6/7-9	9	86
1964	5/19-6/22	35	6/4-12	9	84
1965	5/17-6/14	28	5/24-30	6	91
Averages		38		10	87

TABLE 6

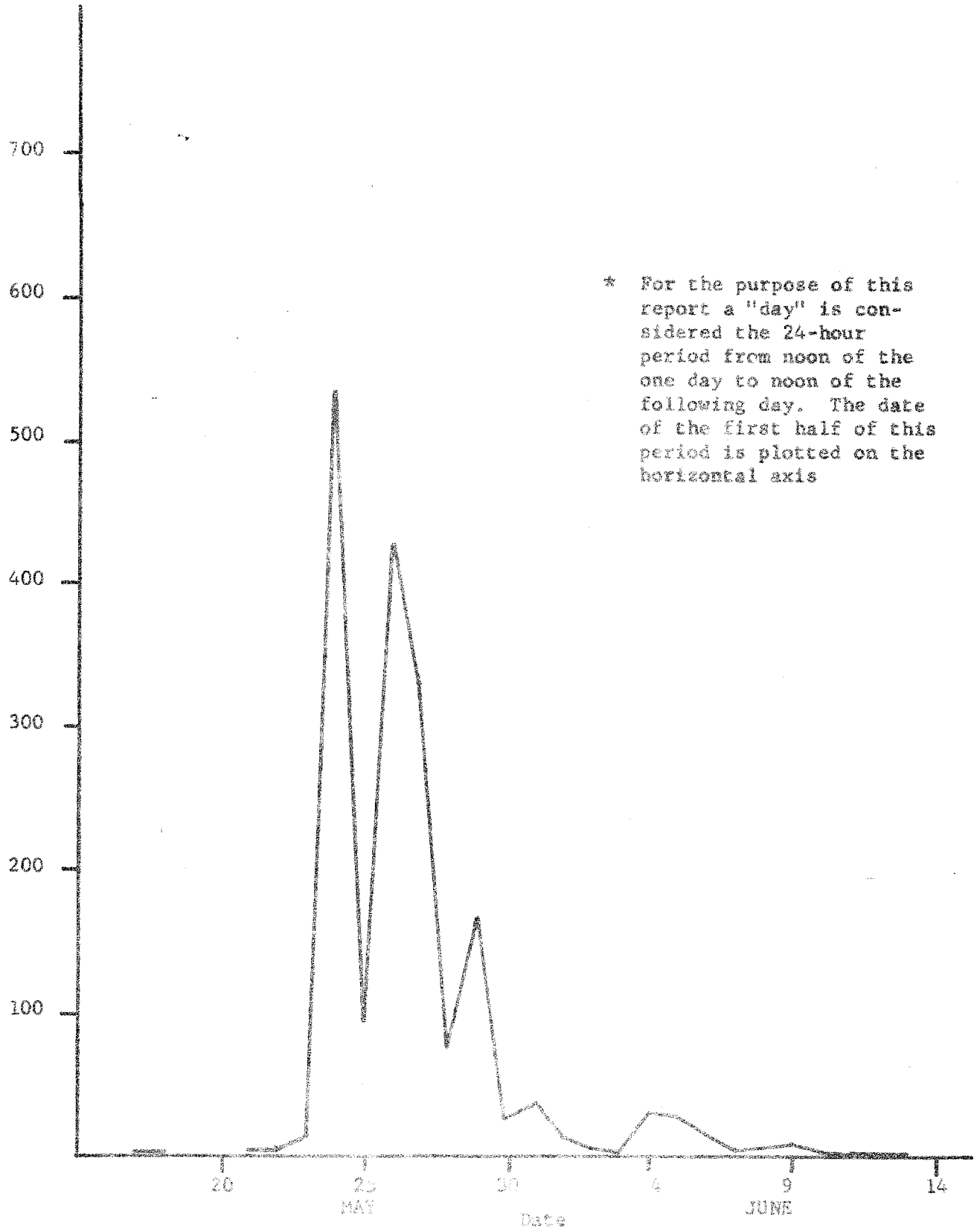
PERCENT OF RED SALMON SMOLT OUTMIGRATION OCCURRING DURING INDEX HOURS (2200-0100)
Kvichak River, 1955-1965

Year	Total 24-Hour Outmigration 1/	Percent Outmigration During Index Hours(2200-0100)
1955	259,978	82.3%
1956	77,660	82.3
1957	30,907	82.3
1958	3,333,953	57.4
1959	2,863,876	57.4
1960	614,003	74.1
1961	36,164	82.3
1962	1,203,000	25.1
1963	4,229,431	32.6
1964	2,061,586	38.3
1965	1,812,555	48.9
Averages	1,502,101	60.1 2/

1/ The methods used to expand the 3-hour index catches to 24-hour catches for the years 1955, 1956, 1959, 1960 and 1961 are explained in the 1964 smolt report.

2/ Note that the average 60.1% migration during the index hours is probably high as the percent for three of the four years showing 82.3% was assumed on the basis that 82.3% of the smolt in 1957 migrated during the index hours. Sampling was not on a 24-hour basis for the years 1955, 1956, 1959, 1960 and 1961.

Figure 7
Red Salmon Smolt Fyke Net Catches by Day*
Kvichak River, 1963



* For the purpose of this report a "day" is considered the 24-hour period from noon of the one day to noon of the following day. The date of the first half of this period is plotted on the horizontal axis

Figure 3
DAILY PERCENT OF AGE II RED SALMON SMOLT
IN FYKE NET CATCHES, KVICHAK RIVER, 1965

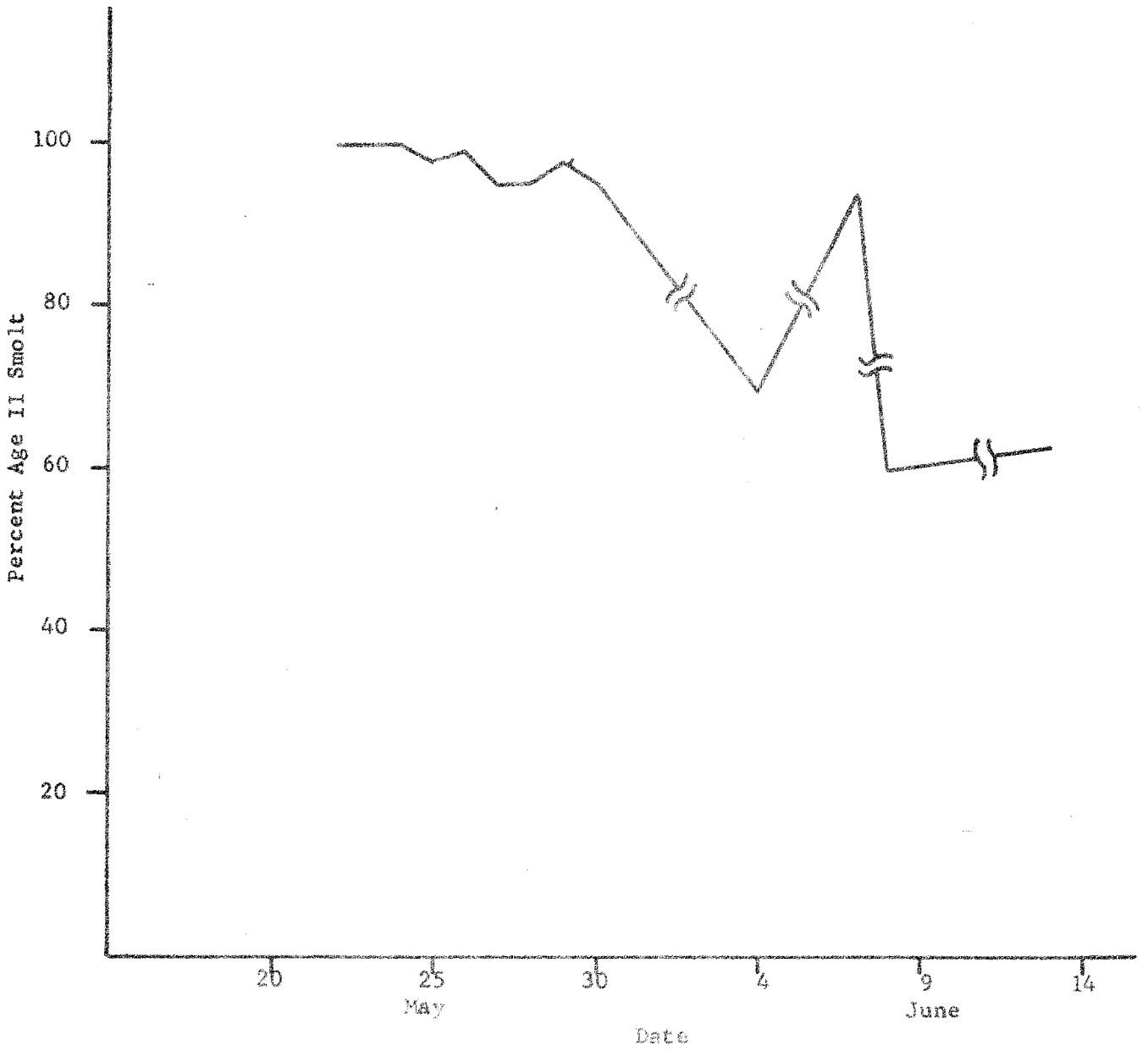


TABLE 7

KVICHAK RIVER RED SALMON SMOLT
WEIGHTED LENGTH FREQUENCY DISTRIBUTION, 1965

(In Terms of 24-Hour Index Catch)

Age I		Age II	
Length in mm.	No.	Length in mm.	No.
75	1,338	96	20,964
76	1,338	97	26,438
77	1,338	98	8,165
78		99	15,266
79	2,277	100	35,904
80		101	54,526
		102	104,838
81		103	79,038
82		104	113,476
83	154	105	109,890
84	114	106	66,733
85	1,093	107	152,940
86	5,056	108	62,769
87		109	88,246
88	4,476	110	179,496
89	4,055	111	100,145
90	3,140	112	123,778
91	13,692	113	51,981
92	3,208	114	59,565
93	3,572	115	40,019
94	2,097	116	31,016
95	17,429	117	34,801
		118	60,568
Total	64,377	119	29,112
Percent	3.6	120	32,123
		121	382
Average Length	90.1	122	7,839
		123	2,897
		124	3,159
		125	21,643
		126	29,260
		127	262
		128	
		129	
		130	939
		Total	1,748,178
		Percent	96.4
		Average Length	108.9

on May 26 the daylight and darkness samples had the same average length while on May 31, the smolt in the darkness sample averaged 109.1 mm. and the smolt in the daylight sample averaged 103.6 mm. On May 26, the water was turbid while on May 31 it was clear. This could mean that in clear water during the daylight hours, the larger fish were avoiding the net; however, too few samples were taken to positively evaluate this conclusion.

During the course of the season five samples were taken to determine the average weight of smolt per three millimeter length grouping. Each of these samples was weighed by the index net catch for the corresponding period of time and an average weight per three millimeter grouping for the season was obtained. This figure, in turn, was weighed by the number of smolt in each 3 mm. grouping to obtain the average weight of smolt for the season. Age I fish averaged 6.8 grams and Age II fish, 11.3 grams.

IV.) COMPARISON WITH PAST DATA.

Table 8 and 9 give comparative 3-hour and 24-hour index catches, percentage age composition, and average length and weight of smolt for the outmigrations 1955-1965. Table 10 compares smolt production from the brood years 1955-1963 while Table 11 gives the percent Age II smolt in terms of 24-hour index catch produced by the brood years 1952-1962.

The 1965 twenty-four hour index catch of Age II smolt was the third largest recorded, exceeding even that of 1964. Combined with the significant catch of Age I fish in 1964, this gives the 1962 brood year the third largest total index production of any year since 1952, and the highest relative production (index smolt per spawner) of any year (Table 10). Although the 79 percent Age II smolt from the 1962 brood year is high (average percent Age II smolt produced for all brood years since 1952 is 59%), it is still a reduction from the 93% Age II smolt produced by the 1961 brood year. (Table 11). This may be a reflection of the smaller escapement size, 2,580,884 in 1962 compared to 3,705,849 in 1961 and the fact that at no time were these smolt in competition with the progeny of the large 1960 escapement.

Age II smolt in the 1965 outmigration averaged 109 mm. in fork length and 11.3 g. in weight. Although more numerous in the index catch than the Age II progeny of 1961, they averaged one millimeter larger and 1.5 grams heavier. This may also be a result of the fact that the progeny of the 1962 escapement were not in lake residence at the same time as the progeny of the large 1960 escapement.

As might be expected, only 64,377 Age I smolt were recorded. These are the progeny of the small, 338,760 escapement in 1963. These fish averaged longer and heavier than the Age I smolt in the 1963 and 1964 outmigrations.

The 1962 escapement of 2,580,884 is the largest recorded since 1952 for a year in the cycle other than the peak year or the year immediately following the peak year. The 1954 and 1958 brood years, also peak year plus two in their

Figure 4

Weighted Length Frequency Curve
for Red Salmon Smolt
Kvichak River - 1965

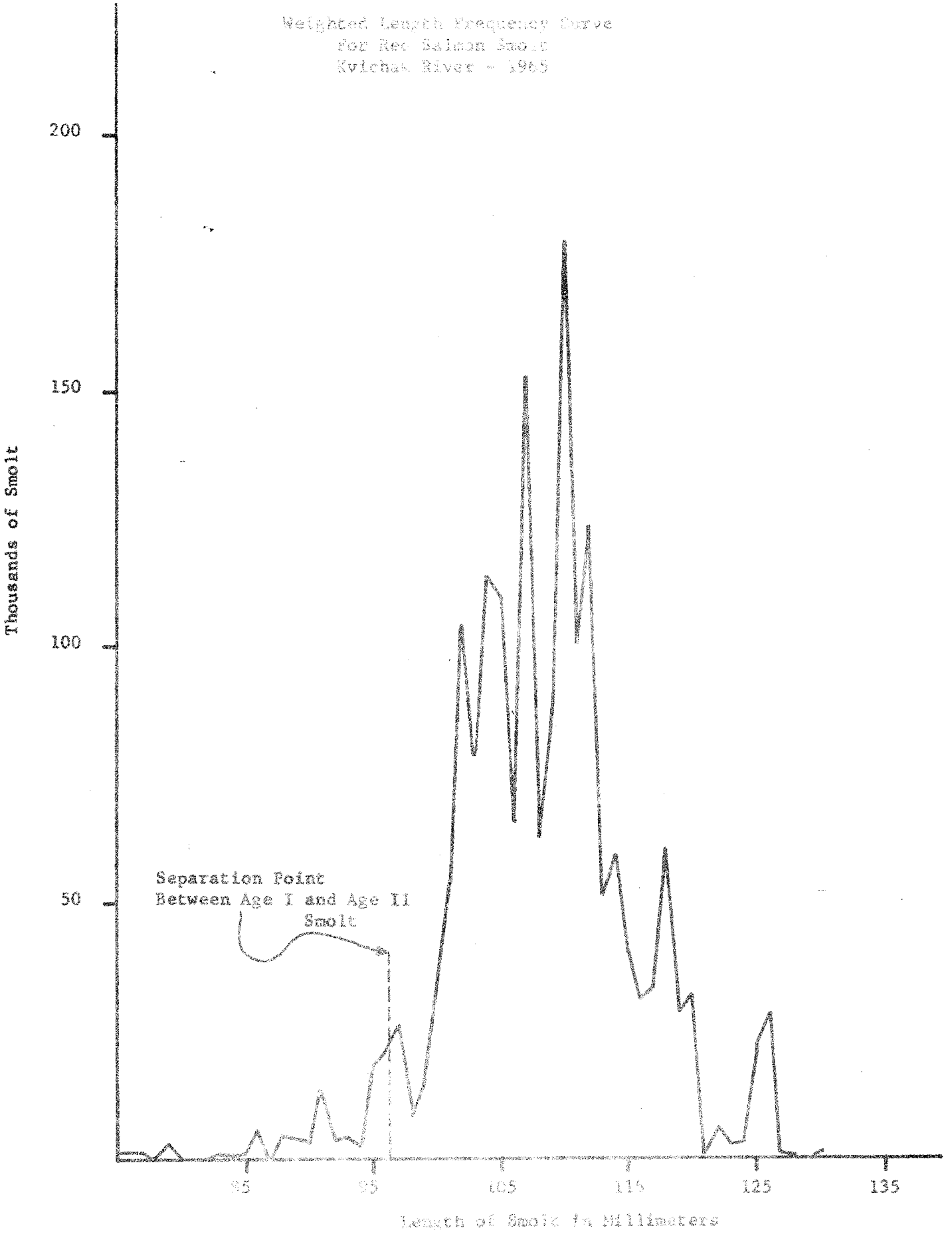


TABLE 8

KVICHAK RIVER 3-HOUR RED SALMON SMOLT CATCHES, 1955-1965

3-Hour Index Catches

Year of Outmigration	Age I		Age II		Total	Total 3-Hour Inc
	Number	Percent	Number	Percent	Number	
1955	14,971	7	198,897	93	213,868	6.4
1956	24,916	39	38,970	61	63,886	1.9
1957	18,306	72	7,119	28	25,425	0.8
1958	1,874,512	98	38,255	2	1,912,767	57.4
1959	49,292	3	1,593,781	97	1,643,073	49.3
1960	45,478	10	409,305	90	454,783	13.6
1961	21,420	72	8,330	28	29,750	0.9
1962	283,328	94	18,085	6	301,413	9.0
1963	41,424	3	1,339,379	97	1,380,803	41.4
1964	173,919	22	616,623	78	790,542	23.7
1965	34,009	4	816,212	96	850,221	25.5
Eleven-Year Averages	234,689	34	462,269	66	696,958	20.9

1/ One Index Point = 33,340 Smolt

TABLE 9

3

KVICHAK RIVER 24-HOUR RED SALMON SMOLT CATCHES
AVERAGE LENGTHS AND WEIGHTS, 1955-1965

Outmigration	Age I Number	Age I 2/ Percent	Age I Average Length	Age I Weight	Age II Number	Age II Percent	Age II Average Length	Age II Weight	Total Number	Total Hour 1/ 24-Index
1955	18,198	7	89 mm	-	241,780	93	109 mm	-	(259,978) 3/	7.8
1956	30,287	39	92 mm	-	47,373	61	116 mm	-	(77,660) 3/	2.3
1957	22,253	72	96 mm	7.3 g	8,654	28	120 mm	14.4 g	30,907	0.9
1958	3,267,274	98	84 mm	4.6 g	66,679	2	114 mm	-	3,333,953	100.0
1959	85,916	3	80 mm	-	2,777,960	97	99 mm	7.6 g	(2,863,876) 3/	85.9
1960	61,400	10	91 mm	6.3 g	552,603	90	108 mm	10.3 g	(614,003) 4/	18.4
1961	26,038	72	92 mm	6.8 g	10,126	28	117 mm	13.1 g	(36,164) 3/	1.1
1962	1,130,820	94	82 mm	4.3 g	72,180	6	110 mm	9.9 g	1,203,000	36.1
1963	113,338	3	83 mm	4.8 g	4,116,093	97	98 mm	7.5 g	4,229,431	126.9
1964	458,122	22	87 mm	5.2 g	1,603,464	78	108 mm	9.8 g	2,061,586	61.8
1965	64,377	4	90 mm	6.8 g	1,748,178	97	109 mm	11.3 g	1,812,555	54.4
Eleven-Year Averages	479,820	32	88 mm	5.8 g	1,022,281	68	110 mm	10.5 g	1,502,101	

1/ One index point= 33,340 smolt

2/ Numbers of Age I and Age II fish derived from rounded off season percentages except in 1963, 1964 and 1965 when rounded percentages were derived from numbers of smolts obtained by weighting length frequency distribution by daily catches.

3/ 24-Hour index catch estimated by ratios with years of actual 24-hour fishing and from visual observations of smolt migration outside the three-hour index period.

4/ 24-hour index catch estimated from ratios with the three-hour index period catch obtained during only two days of actual 24-hour fishing.

TABLE 10

PARENT ESCAPEMENT AND CORRESPONDING RED SALMON SMOLT PRODUCTION, KVICHAK RIVER, 1952-1963

Year of Spawning	Escapement In Thousands	24-Hour Index Smolt Produced Age I	Age II	Total	24-Hour Index Smolt Per Spawner x 10^3 Age I	Age II	Total
1952	5,970		241,780			40	
1953	321	18,198	47,373	65,571	57	148	205
1954	241	30,287	8,654	38,941	126	36	162
1955	250	22,253	66,679	88,932	89	267	356
1956	9,443	3,267,274	2,777,960	6,045,234	346	294	640
1957	2,964	85,916	552,603	638,519	29	186	215
1958	535	61,400	10,126	71,526	115	19	134
1959	680	26,038	72,180	98,218	38	106	144
1960	14,630	1,130,820	4,116,093	5,246,913	77	281	359
1961	3,706	113,338	1,603,464	1,716,802	30	433	463
1962	2,581	458,122	1,748,178	2,206,300	178	677	855
1963	339	64,377			190		
Averages	3,472	479,820	1,022,280	1,502,100	138	294	432

TABLE 11

PARENT ESCAPEMENT AND CORRESPONDING
PERCENT OF AGE II RED SALMON SMOLT PRODUCED, 1952-1963

Year	Escapement	Percent Age II 1/ Smolt Produced
1952	5,970,000	10 - 15% 2/
1953	321,000	72%
1954	241,000	22%
1955	250,000	75%
1956	9,443,000	46%
1957	2,964,755	87%
1958	534,785	14%
1959	680,000	73%
1960	14,630,000	78%
1961	3,705,849	93%
1962	2,580,884	79%
1963	338,760	

1/ Based on 24-hour index catches

2/ Estimated on basis of 2-ocean returns in 1956 and 5_2 fish in 1957 vs. 5_3 fish in 1957 and 6_3 fish in 1958.

respective cycles, were relatively poor producers both in terms of index smolt and total production. However, the spawning escapements in these years were only 241,000 and 535,000, respectively. Data on number of smolts produced, percent Age II smolt, and their length and weight tend to suggest that:

(a) Progeny of the year following the peak year are in competition with those of the peak year.

(b) Progeny of the second year following the peak year are not in competition with those of the peak year and in the case of the progeny from the relatively large 1962 escapement are apparently not seriously inhibited by any indirect competition from the peak year.

This may mean that it would be easier to build up the size of the third year in the cycle than the second, although from the data available it seems that the size of both years can be increased by increasing escapement size.

V.) SUMMARY OF 1965 KVICHAK RIVER RED SALMON SMOLT STUDIES.

A. A single fyke net was fished in the Kvichak River in a location and manner consistent with past years. This net was fished as much as possible on a 24-hour day, seven days per week basis during the course of the project.

B. Ice floes did not seriously interfere with the fishing of the net. There was a great deal of debris in the river and the water was often very turbid. Water temperatures varied from a low of 32° F. to 48° F. during the project. The period of peak outmigration did not start until water temperatures had reached 41° F.

C. A total of 1,812,555 smolt were estimated to have passed through the net during the period May 18 through June 13. 46.9 percent or 850,221 of these were enumerated during the index hours 2200-0100. These numbers of smolt are the equivalent of 54.4 twenty-four hour index points and 25.5 three-hour index points.

D. Age II smolt from the 1962 brood year comprised 96.4 percent of the outmigration. Age I smolt from the 1963 brood year comprised only 3.6 percent.

E. The average length and weight of Age I smolt was 90 mm. and 6.8 g., respectively. The average length and weight of Age II smolt was 109 mm. and 11.3 g., respectively.

F. Analysis and Conclusions:

(1) The 1965 twenty-four hour index catch of Age II smolt was the third largest recorded in the history of the project.

(2) Total index smolt production from the 1962 parent escapement of 2,580,884 was the third largest in the history of the project exceeding even that of the 1961 parent escapement of 3,705,849.

(3) Relative production in terms of index smolt per spawner was higher for the 1962 brood year than any other in the history of the project.

(4) Average length and weight of both Age I and Age II smolt from the 1962 brood year exceeded those of smolt from the 1961 brood year even though the index catch of smolt from 1962 was higher.

(5) It appears that smolt production from the 1962 escapement was in no way depressed by indirect competition with the large 1960 brood year.

VI.) RECOMMENDATIONS FOR FUTURE SMOLT PROJECTS.

A. Marriott in the 1963 Kvichak smolt report (A D F & G Informational Leaflet No. 48) included an excellent methods and procedures section. This section described the mechanics of fishing the net and photo-counters as well as data collection procedures and analysis. It is recommended that this section be revised as an operational manual to incorporate changes in procedures and techniques in the past two years, standardize methods of analysis and clarify certain points in the original manual. Some of which are:

(1) Interpolation for missing periods. Certain rules of interpolation consistent with past procedures were listed in 1964 and again in 1965. These should be given in their entirety as a guide to future workers. The method of time period ratio interpolation used in 1963 was not used in any other year.

(2) Entry and interpretation of hourly fishing data. Confusion has arisen from the fact that the examples of fishing data recording in the 1963 report do not indicate how the catches were interpreted. In the fyke net log all the times of raising and lowering the net tunnel either to replace cod ends or calibrate photo-counters are listed. Of course, when the tunnel is held out of the water the net is still fishing because no fish can pass through, but under fishing time in the fyke net log the difference between "set" and"pulled" is listed as the minutes fished. Re-examination of the raw data indicates that the author did, in fact, ignore these set and pull times in the overall calculation of fishing time, unless the net tunnel was left open in the water, and only used them for passage rate analysis. This transition is not made clear in text or examples, however, and due to the complete change in supervision of this project, it has led to some confusion in the handling of the data and should be clarified.

(3) Procedures of scale, weight and length data collection. These have been modified and should be spelled out.

B. As mentioned in the text, it is felt that a great deal of variation is possible in the mechanics of calibrating the photo-counters. This is especially true at high migration levels when an unalert crew member not pulling the photo tunnel out of the water quickly or far enough may allow 5-20 additional pounds of smolt to build up in the cod end. Actually, it is surprising that the calibrations have averaged so closely each year. It has been noted, however, that

photo-counter efficiency tends to drop off at high passage rates. It is possible that instead of the photo-counter efficiency dropping off, the ability of the crew to handle the fish decreases. Two other possible sources of error are the lowering of the tunnel after attaching the cod end and after removal of the cod end. At high migration levels large masses of fish accumulate in the net throat while the tunnel is held above the water. When the tunnel is lowered, the counters are not reset until the tunnel is completely under water to avoid turbulence counts. Even in this short period, the pressure built up by the large number of accumulated smolt forces many through that are not counted. These errors can be alleviated by the following possible courses:

(1) The importance of "turbulence" counts should be evaluated. If insignificant or constant, they could probably be discounted during the lowering of the tunnel and the counters could be reset before the tunnel was completely submerged, thus not losing any fish.

(2) A few seconds could be allowed to elapse after lowering the tunnel without the cod end before the counters were reset and the time recorded to allow accumulated fish to pass through prior to resumption of counting.

(3) Equipment could be modified to shut off flow of fish until the tunnel is submerged.

C. The number of separate daylight and darkness length frequency samples taken should be increased to evaluate the question of net avoidance.

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